Maintenance of Highway Edgedrains

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February 2002

Maintenance is required to keep pavement subsurface drainage open so that the pavement structure will drain. Just about all State highway agencies (SHA's) that have constructed subsurface drainage systems recognize that maintenance is a problem. Vegetative growth around the pipe outlets, rodent-s nests, mowing clippings, and sediment collecting on rodent screens at headwall are common maintenance problems. Some outlets have been so plugged that water has gushed from the pipes when they were unplugged.

The purpose of this paper is to identify maintenance problems with edgedrains and document FHWA attempts at stressing the importance of maintenance to SHA's. A description of the various maintenance problems encountered by SHA's follows.

An example of vegetative material removed from an edgedrain is shown in Photo No. 1, while an edgedrain pipe blocked by a rodent-s nest is shown in Photo No. 2.

Photo No. 1 Vegetative Material Removed from an Edgedrain System

Photo No. 2 Rodent's Nest

Crushed pipe are shown in Photo No. 3 and 4. Most likely these pipe were crushed during construction.

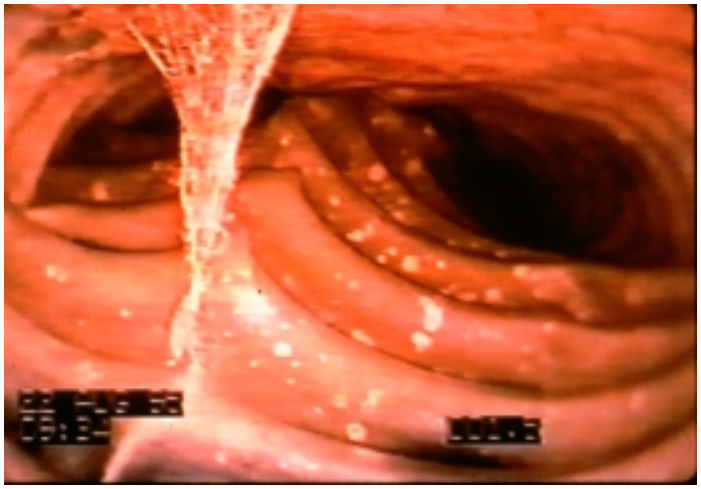

Photo No. 3 Crushed Pipe

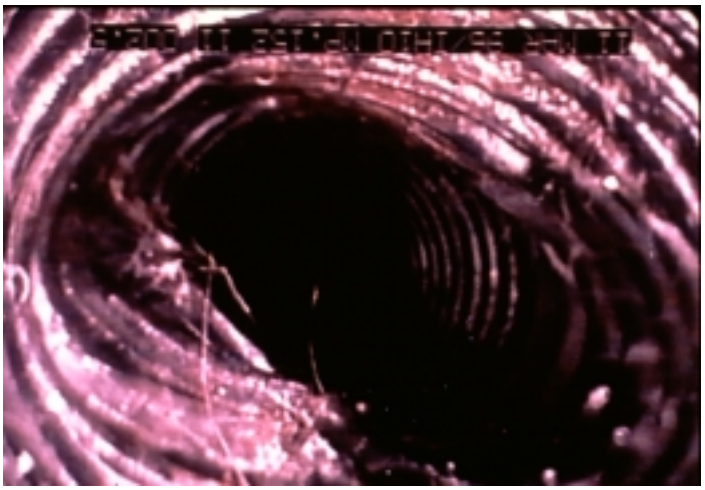

Photo No. 4 Crushed Pipe

Often outlets cannot be found because they are hidden by vegetative growth. Photo No. 5 shows a typical hidden and crushed outlet. Note that there is no headwall.

Photo No. 5 Hidden Outlet Pipe

It is obvious that if maintenance personnel can not find the outlets, no maintenance can be performed. SHA's that use concrete headwalls, reference markers, signs on fences, reflector disks in the shoulder, or painted arrows on the shoulders have better success in providing maintenance. It is also important that maintenance activities not block or damage the pipe outlet. A simple arrow painted on the edge of the shoulder, as shown in Photo No. 6, is a good reference marker for maintenance personnel.

Photo No. 6 Painted Arrow as a Reference Marker

One of the purposes of a headwall is to eliminate erosion at the pipe outlet. Unfortunately, excessive erosion at an edgedrain outlet is shown below in Photo No. 7.

Photo No. 7 Excessive Erosion at the Outlet Pipe

Larger headwalls, as shown in Figure No.8 have the following advantages:

- $ Easier for maintenance personnel to locate
- $ Roadside vegetation located farther away from the outlet pipe.
- $ Reduce erosion
- $ Prevents crushing of the outlet pipe.

Photo No. 8 Large Outlet Pipe Headwall

Video inspection of edgedrains has two important benefits for SHA-s:

Quality assurance for new construction
Identify maintenance problems

Photo No. 9 shows a section of edgedrain that has collapsed. This problem was identified by video inspection.

Photo No. 9 Crushed Edgedrain Pipe

In Photo No. 10, the video inspection camera is approaching the main line longitudinal edgedrain. It will be difficult for the camera to make this turn from the outlet pipe to the edgedrain. It will also be difficult for any cleaning equipment to make the turn. This is why FHWA recommends large radius pipe or a combination of bends to make the turn.

Photo No. 10 Ninety Degree Tee

If flexible corrugated plastic pipe has been used as an edgedrain, the pipe will not be perfectly straight since the pipe has a tendency to coil during the laying process. Any low points in the edgedrain provide an opportunity for sediment to build up. Periodic flushing of the edgedrain may be necessary to remove sediment build up.

Flushing or jet rodding the system is important in the maintenance scheme. It is important that the pipe have proper bends to facilitate this operation. The edgedrain pipe system should be designed with maintenance in mind. These operations should be done on a routine schedule.

A pipe flushing unit is shown in Photo No. 11. The water jets point towards the rear of the unit so that the jetting action helps to propel the unit through the pipe.

Photo No. 11 Pipe Flushing Unit

Edgedrain outlets and pipe systems should be inspected at least once a year to determine their condition. Use of video equipment to inspect the edgedrain pipe is recommended. Flushing of the pipe system should be performed as necessary.

Maintenance personnel should mow around the outlet pipes at least twice a year. It is important to perform the mowing on a periodic basis to keep vegetative build up to a minimum. Roadside ditches should also be mowed and kept clean of debris.

The need for maintenance was first expressed in **Technical Paper No. 90-01 ASubsurface Pavement Drainage:@**

> "Maintenance is critical to the continued success of any longitudinal edgedrain system. Inadequate maintenance is an universal problem. The combination of vegetative growth, debris, and fines discharging from the edgedrains will eventually plug the outlet pipe."

This theme has been expressed in the following FHWA drainage efforts:

Final Report, Experimental Project No. 12, AEffectiveness of Highway Edgedrains@

Participant Notebook, Demonstration Project No. 87, ADrainable Pavement Systems@

Final Report, AVideo Inspection of Highway Edgedrain Systems@

Reference Manual, NHI Course No. 130126, APavement Subsurface Drainage Design@

Reference Manual, Drainage Construction Workshops, AConstruction of Pavement Subsurface Drainage Systems@

FHWA=s guidance in all of these efforts is the same: if a SHA is unwilling to make the necessary maintenance commitment, subsurface drainage systems should not be provided.

<u>Demonstration Project No. 87 (Demo 87) "Drainable Pavement Systems</u>"

Section 15.0 Maintenance of Demo 87 stresses the need for maintenance. The most important statement in this section follows:

"If an SHA is unwilling to make a maintenance commitment, permeable bases should not be used since the pavement section will become flooded. This increases the rate of pavement damage."

NHI Course 131026, APavement Subsurface Drainage Design@

Chapter 10, Maintenance, of the Reference Manual for the NHI Course No. 131026, APavement Subsurface Drainage,@ provides an extensive discussion of maintenance problems. The manual lists the following problems for longitudinal edgedrains:

AFor permeable bases with longitudinal edgedrains:

Crushed or punctured outlets that are left unattended for long periods of time.
Outlet drains that are clogged with debris, mice nests, mowing clippings, vegetation, and sediment.
Edgedrains (both pipe drains and fin drains) that are filled with sediment, especially at sags and slopes of less than 1 percent.
Missing rodent screens at the outlets.
Missing outlet markers.
Erosion around outlet headwalls.
Shallow ditches that have inadequate slopes and that are clogged with vegetation.@

Below is a list of problems associated with daylighted permeable bases:

AFor daylighted permeable bases:

Excessive vegetative growth over the daylighted portion.
Deposition of roadside debris.
Silting of the daylighted openings.@

The Reference Manual makes the following salient recommendations:

AIt was concluded that maintenance is not an option but a necessity.

AIt was recommended that maintenance be made an integral part of the subsurface drainage policy of any given agency.@

Two relatively recent NCHRP Synthesis provide excellent discussions on the need for maintenance.

NCHRP Synthesis 239 APavement Subsurface Drainage Systems@

NCHRP Synthesis 239, APavement Subsurface Drainage Systems@ is an up date of the previous Synthesis 96 with the same title.

One of the main contributions that this synthesis makes is the use of the team approach. The synthesis stresses the need for coordination and cooperation between planners, designers, construction personnel and maintenance people. While this concept is certainly not new, subsurface drainage is certainly an area where the team approach has merit.

The cost effectiveness of drainage systems is recognized by the following conclusions:

> APavement subsurface drainage is a major factor in extending the life of a pavement.@
>
> AAlthough performance indicators to quantify the benefits of pavement subsurface drainage systems have not been established, use of a permeable base with a free-draining outlet system generally has demonstrated the best performance of all subsurface drainage strategies.@
>
> AThe cost of pavement drainage system is high in terms of materials, construction, and maintenance, but the extended pavement life anticipated appears to make these systems cost-effective.@

The need for maintenance is recognized by the following conclusions:

> AA plugged subsurface drainage system may be worse than having no drainage system at all because the pavement system becomes permanently saturated.@
>
> "Maintenance efforts vary between good and nonexistent within and among states.@
>
> "Long-term maintenance is essential for obtaining the anticipated benefits of pavement subsurface drainage systems.@

NCHRP Synthesis 285 AMaintenance of Highway Edgedrains

The new NCHRP Synthesis 285, AMaintenance of Highway Edgedrains,@ provides a very insightful look into the problems associated with edgedrain maintenance. This synthesis is an extension of Synthesis 239 in which the need for maintenance was stressed. The conclusions listed below are extremely important since they hit at the heart of the problem.

In the area of pavement performance and benefits, the synthesis draws the following conclusions:

> AThe cost of maintenance is far outweighed by the anticipated design life of the road that comes with edgedrains that perform.@

AThere is a significant cost in terms of poor performing pavements to agencies that use edgedrains and do not have an effective preventive maintenance program.@

ALong term maintenance is essential to obtain the anticipated benefits of drainable pavement systems.@

The merits of pavement subsurface drainage are recognized by the following conclusion:

ABased on the results of NCHRP Synthesis 239 and confirmed by literature reviewed in this synthesis, there is a significant cost in terms of poor pavement performance to agencies that are not using edge drains.@

The need for quality control in construction is acknowledged by the following conclusions:

AEdgedrain failures have occurred where the water could not get out of the base fast enough (e.g., no pipe outlets, plugged outlets, crushed outlets, clogged filters, or clogged drains). Many drainage system failures are traced to poor construction and inspection.@

ATraining of construction and inspection staff is important to improve drainable pavement performance.@

The need for qualified and trained maintenance personnel is seen in the following conclusion:

AAll maintenance personnel should be made aware that a plugged subsurface drainage system may be worse than no drainage system because the pavement system becomes permanently saturated.@

Two of the most scathing conclusions were:

AMaintenance efforts vary between good and nonexistent within a state and among different states.@

AThere is an apparent disconnect between maintenance, design and construction in many state agencies.@

Summary

If a SHA is unwilling to make a maintenance commitment, permeable bases should not be used since the pavement section will become flooded. This will increase the rate of pavement damage (FHWA 1992, Christopher 1997).

REFERENCES

1. **Christopher, B.R., McGuffey, V.C., "Pavement Subsurface Drainage System," NCHRP Report No. 239, 1997, Transportation Research Board, National Research Council, Washington, D.C.**

2. **Christopher, B.R., "Maintenance of Highway Edgedrains," NCHRP Report No. 285, 1997, Transportation Research Board, National Research Council, Washington, D.C.**

3. **Daleiden, J., AVideo Inspection of Highway Edgedrain Systems,@ Final Report, Brent Rauhut Engineering, January 1998.**

4. **Federal Highway Administration, "Drainable Pavement Systems," Participants Notebook, Office of Technology Applications, and Office of Engineering, 1992, 400 7th Street, SW., Washington, D.C. 20590**

5. **Federal Highway Administration, Technical Guide Paper 90-01, "Pavement Subsurface Drainage," October 1990, Pavement Division, 400 7th Street, SW., Washington, D.C. 20590.**

6. **Jeffcoat, H. H., Kilpatrick, F. A., Atkins, J. B., Pearman, J. L., "Effectiveness of Highway Edgedrains," Final Report - Experimental Project No. 12, Concrete Pavement Drainage Rehabilitation, Report No. WRRI 92-4147, $13.00, U.S. Geological Survey, Water Resources Division. Available from: U.S. Geological Survey, Books and Open-File Reports Section, Box 25286, Federal Center, Denver, CO 80225.**

7. **NHI Course No. 131026, APavement Subsurface Drainage Systems,@ Reference Manual, April 1999.**